Request for Information

General Information

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1. Background

The NASA Aeronautics Research Mission Directorate has recently restructured its Aeronautics Research into three separate Programs: *Fundamental Aeronautics*, *Aviation Safety*, and *Airspace Systems.* The specific purpose of this Request for Information (RFI) is to solicit external interest in collaborative public-private research partnerships under NASA's Fundamental Aeronautics Program:

Fundamental Aeronautics Program: The top-level goal of this program is the development of system-level, multi-disciplinary capabilities for both civilian and military applications. This program provides long-term investment in research to support and sustain expert competency in critical core areas of aeronautics technology.

While not part of this RFI, separate RFIs will also be issued for NASA's other two Aeronautics Research Programs:

Aviation Safety Program: This program will build upon the unique safety-related research capabilities of NASA to improve aircraft safety for current and future civilian and military aircraft, and to overcome aircraft safety technological barriers that would otherwise constrain the full realization of the Next Generation Air Transportation System. This program will also provide long-term investment in research to support and sustain expert competency in critical core areas of aviation and aircraft safety.

Airspace Systems Program: The top-level goal of this program is the development of high capacity, efficient, and safe airspace and airportal systems that will enable the Next Generation Air Transportation System, as defined by the Joint Planning and Development Office.

2. Description

Under this RFI, NASA solicits interest primarily from industry to collaborate at the systems level in Fundamental Aeronautics. NASA seeks to enter into research collaborations that benefit both industry and NASA, and NASA intends to use its authority under the National Aeronautics and Space Act of 1958, as amended ("Space Act"), to enter into non-reimbursable agreements where each party funds their own participation in the research effort. One or more initial agreements are anticipated. NASA is particularly interested in collaborating with industry consortia, and responses from existing or proposed consortia are encouraged. While educational institutions may also respond to this RFI, it is anticipated that a NASA Research Announcement (NRA) soliciting participation by educational institutions, non-profit organizations, and companies engaged in foundational research will be issued in early 2006.

The Fundamental Aeronautics Program encompasses core capabilities in the four (4) thrust areas of Subsonic Fixed Wing, Subsonic Rotary Wing, Supersonics and Hypersonics. See **Appendix A** for a more detailed description of the Fundamental Aeronautics Program. Fundamental Aeronautics also supports NASA's Vision for Space Exploration by providing key aeronautical capabilities that can be adapted for high-speed vehicles exiting and entering the atmosphere of our planet as well as operating throughout the atmospheres of other planetary bodies such as Mars.

This RFI solicits proposed research collaborations that are appropriate to NASA's unique capabilities. NASA intends long-term support in the thrust areas described above. NASA intends to focus its resources on fundamental technology and build upon that investment to develop system-level, multidisciplinary capabilities that enable both civilian and military platforms of the future. As NASA does not typically build or operate military or commercial aircraft, we seek partnerships with industry at the systems level.

Consistent with the Space Act, a key element of the restructured Aeronautics program is that the Nation's aeronautical expertise and unique facilities are maintained as national assets for the benefit of both civilian and military aeronautics applications.

3. Process

NASA Headquarters oversees the Aeronautics Research Programs and implementation occurs principally at four NASA field centers (Ames Research Center, Langley Research Center, Glenn Research Center, and Dryden Flight Research Center). In Fiscal Year 2006 a four-step process will be used to define the Aeronautics Research Programs:

Step 1: Assess the long-term research needs and goals in the Fundamental Aeronautics program and establish technical roadmaps to accomplish those goals. In developing those roadmaps, prioritize according to NASA's unique strengths and capabilities. Establish multi-center, multidisciplinary teams across the areas of Subsonic Fixed Wing, Subsonic Rotary Wing, Supersonics, and Hypersonics. These roadmaps will be discussed further at the 44th American Institute of Aeronautics and Astronautics (AIAA) Aerospace Sciences Meeting and Exhibit, January 9-12, 2006 in Reno, Nevada.

Step 2: Solicit information through this RFI on the key areas of interest from the external community and determine potential areas to form collaborative arrangements.

Step 3: Develop research proposals at the field centers in each of the four thrust areas and establish NASA research teams. The responses to this RFI will provide important source material to the NASA research teams to be used in establishing specific collaborative partnerships as part of their proposals to NASA Headquarters.

Step 4: NASA intends to issue NASA Research Announcements (NRA, see NASA Federal Acquisition Regulation Supplement Part 35) to solicit proposals for foundational research in areas where NASA needs to enhance its core capabilities. Foundational research is defined as research that furthers our fundamental understanding of the underlying physics, chemistry, materials, etc. NASA anticipates that educational institutions, non-profit organizations and industry engaged in foundational research will be the primary recipients of awards under the NRA.

4. Information for Respondents

4.1 How to Respond

NASA anticipates providing additional information about its Aeronautics Research Programs on or about January 12, 2006, at the AIAA conference in

Reno, Nevada. NASA also anticipates providing this additional information on the following website: www.aeronautics.nasa.gov.

The website above will be used to post information about, or modifications to, this RFI. Prospective respondents are urged to periodically check this web site for updates.

Respondents are requested to provide a description of a proposed non-reimbursable partnership between NASA and industry. Responses shall describe: (1) the respondent's team and expertise, key personnel and capabilities, and the R&D collaboration approach and areas of interest; (2) respondent's facilities and resources (including test data) to be provided as part of the collaboration; and (3) what is expected or requested of NASA as part of the collaboration (including Government facilities or other resources). Partnerships will be limited to US companies. Of particular interest are industry consortia focused on intellectual collaboration at the systems level in one of the four Fundamental Aeronautics Program thrust areas.

Responses must be a maximum of five (5) pages, with minimum 12-point Times font. All proposals shall include the company name, point-of-contact, address, and phone number. All proposals shall clearly indicate which one of the four thrust areas in the Fundamental Aeronautics Program is addressed in the proposed partnership, by placing the name of one program thrust (either "Subsonic Fixed Wing", "Subsonic Rotary Wing", "Supersonics", or "Hypersonics") in the upper right hand corner of each page in your proposal. All proposals shall include an e-mail address for the point-of-contact in order to expedite communications. All questions posed by email shall get a response.

Please submit all responses in electronic format to the Point-of-Contact listed below by **NOON Eastern Standard Time, January 31, 2006**:

Name: Mr. Herb Schlickenmaier
Title: Deputy Director, Fundamental Aeronautics
Phone: 202-358-4638
Email: rfi_fa@nasa.gov

Questions regarding this RFI should also be addressed to the above Point-of-Contact.

4.2 Evaluation Factors

The evaluation process NASA intends to use for selecting collaborative partnerships (under non-reimbursable Space Act Agreement[s]) has been designed for this RFI. Respondents are reminded that this process does not involve the procedures set forth in the Federal Acquisition Regulation (FAR) nor the NASA FAR supplement since this announcement will not result in the award of a contract, grant, or cooperative agreement.

Responses will be assessed on the following evaluation factors:

- Overall responsiveness to furthering the goals of this RFI, in particular the objectives and results-oriented goals of NASA's Fundamental Aeronautics Program.
- Management Confidence in the structure and management of the proposed collaborative activity through the formation of Industry consortia.
- Technical Confidence in the research proposed under the collaborative activity on system level topics.
- Interest in long-term, rather than short-term research.

The NASA Point-of-Contact referenced in Section 4.1 will provide the RFI responses to the NASA planning lead of the thrust area identified by the respondent. Based upon assessment of the responses, as part of the process of submitting proposals under Step 3 (see "Process" above), the planning leads may contact RFI respondents to finalize terms and conditions of agreements.

4.3 General Information

4.3.1 Proprietary or Confidential Information

Respondents are NOT to provide any information that is considered proprietary, trade secrets, or privileged or confidential.

4.3.2 Intellectual Property

Intellectual property rights between NASA and collaboration partners can be negotiated to fit the goals of the parties. Under NASA's standard approach, title to inventions remain with the respective inventing parties without any exchange of rights unless otherwise agreed. Proprietary data developed and provided by the collaboration partner to NASA remains proprietary. NASA takes no rights in background inventions or data developed prior to or outside of collaborative agreements under this RFI.

NASA requires that consortia and teams agree to intellectual property rights among members prior to finalizing terms and conditions of a non-reimbursable Space Act Agreement.

Respondents to this RFI may comment on this general approach and/or suggest alternate approaches to intellectual property rights between NASA and the partner.

4.3.3 Compliance with U.S. Laws, Regulations, and Policies

Proposals must comply with all applicable U.S. laws, regulations and policies.

4.3.4 Use of Government Resources

In support of this RFI, the Government will consider requests from respondents for Government furnished resources and technologies. Requests for use of Government equipment, facilities or services should be provided to the Point-of-Contact for this RFI.

4.3.5 Period of Performance

The Government anticipates that proposed research collaborations under Space Act Agreements will have an initial period of performance of five (5) years, unless otherwise agreed to by the parties

4.3.6 RFI Issuance and Response Selection

NASA will not issue paper copies of this RFI. NASA reserves the right to select for negotiations all, some, or none of the proposed collaborative partnerships in response to this RFI.

APPENDIX A: Information on FUNDAMENTAL AERONAUTICS

The Fundamental Aeronautics Program is dedicated to the mastery and intellectual stewardship of the core competencies of Aeronautics for the Nation across all flight regimes. NASA will focus the research in areas that are appropriate to our unique capabilities.

The research is long-term and is both focused and integrated across disciplines. NASA will invest broadly and deeply in the core competencies of aeronautics, producing knowledge, technology, and tools that are applicable across a broad range of air vehicles.

NASA has defined a four-level approach to technology development: (1) conduct foundational research to further our fundamental understanding of the underlying physics and our ability model that physics, (2) leverage the foundational research to develop technologies and analytical tools focused on discipline-based solutions, (3) integrate methods and technologies to develop multi-disciplinary solutions, and (4) solve the aeronautics challenges for a broad range of air vehicles with system-level optimization, assessment and technology integration.

Interaction with the aeronautics community aligns with the four levels. The first three levels reflect relationships with the aeronautics community in which NASA seeks to ensure the national aeronautical technical expertise: (1) NASA will advance the state of knowledge of the underlying physics and its modeling by partnering with universities and companies engaged in foundational research where that partnership supplements NASA capabilities, (2) NASA will investigate discipline-related challenges and will interact with the aeronautics community through published reports and direct technology transfer, and (3) NASA will develop multi-disciplinary methods and technologies, and disseminate them in published reports and direct technology transfer.

The interaction with the aeronautics community at the systems level is unique because NASA typically does not design and build air vehicles for operational use. We look toward collaboration with industry to provide insight into issues associated with flight, manufacturing and design. NASA's role at this level is to develop multidisciplinary design, analysis, and optimization tools based on the underlying physics. NASA intends to collaborate with industry consortia to provide value to industry of a more enduring nature, rather than immediate design and manufacturing problem-solving.

The following four thrust areas describe the objective, anticipated results and more detailed areas of investment for Subsonic Fixed Wing, Subsonic Rotary Wing, Supersonics and Hypersonics.

A.1 SUBSONIC FIXED WING

OBJECTIVE: Perform foundational research in materials and structures, tribology, power and combustion, dynamics and control, aeroacoustics, aerodynamics, aerothermodynamics, and experimental methods to enable revolutionary capabilities in propulsion and power systems, vehicle systems integration and analysis, airframe systems, and systems for experimental validation, which will ultimately yield multidisciplinary analysis and optimization capabilities that will enable system-level design of a wide class of air vehicles that are aligned with the Environment objectives in the Next Generation Air Transportation Systems plan and meet the performance challenges of the future for both the civilian and military applications.

RESULTS: Validated, fast and effective physics-based multidisciplinary design, analysis, and optimization capability integrated with high-value technology development including virtual access to the flight envelope, and virtual expeditions through design space that enable system-level design of a wide class of subsonic fixed wing vehicles.

AREAS OF INVESTMENT:

- *Propulsion and Power Systems:* Alternative propulsion and power concepts, materials and structures technologies for durable, active, multi-functional propulsion and power systems, advanced technologies for intelligent engines, and engine icing characteristics to address the trade space of noise, emissions, and performance.
- *Vehicle Integration and Analysis:* Engine and airframe noise source decomposition, advanced control techniques and autonomous control architectures, and aeroelastic analysis methods to address the interaction between engine and airframe.
- *Airframe Systems:* Metallic, composite, and hybrid materials and structures, analysis methods for property characterization, advanced materials, processing and manufacturing technologies, multifunctional materials and structures concepts, expanded design space enabled by high-lift design, edge of envelope stability and control, enhanced, physics-based noise prediction, integrated aerodynamic, acoustic and structural advanced analysis tools.
- *Systems for Experimental Validation:* Autonomous testbeds, high-fidelity piloted simulations, and instrumentation with new capabilities integrated into a multidisciplinary system validated with flight tests as appropriate

A.2 SUBSONIC ROTARY WING

OBJECTIVE: Perform foundational research in materials and structures, engines and drive systems, dynamics and control, aeroacoustics, aerodynamics, aeromechanics, and experimental methods to enable revolutionary capabilities in propulsion and aeromechanics, super-integrated vehicle management system, integrated rotorcraft design, and integrated experimental systems, which will ultimately yield multidisciplinary analysis and optimization capabilities that will enable system-level design of advanced capability vehicles that will meet the noise and performance challenges for both the civilian and military applications.

RESULTS: Validated physics-based multidisciplinary design, analysis, and optimization tools integrated with technology development that enable rotorcraft, with advanced capability, to fly as designed for any mission.

AREAS OF INVESTMENT:

Propulsion-Aeromechanics Integration: Variable speed drive systems, minimal or no-lubricant transmission concepts, component technologies for life extension, and alternative engine designs to address on-condition health management and interior noise concerns.

Super-Integrated Vehicle Management System: Simulations and flight research to validate investigative results of active-control techniques and adaptive displays to address control system design capabilities.

Integrated Rotorcraft Design: Aeromechanics and aeroacoustics predictive design capabilities for rotorcraft of various size, operating in varying flight regimes to address the trade space of performance, loads, vibration, noise, and airloads.

Integrated Experimental Systems: Methodology for real-time comparison of computational fluid- and structural-dynamics with experimental data; integrated diagnostic instrumentation systems into facilities for operational efficiency; simultaneous, multi-parameter diagnostic techniques that enable rapid testing and validation of rotorcraft behavior.

A.3 SUPERSONICS

OBJECTIVE: Perform foundational research in materials and structures, propulsion and power, aeroservoelasticity, sonic boom, dynamics and control, aerodynamics, and experimental methods to enable revolutionary capabilities in propulsion and power systems, vehicle systems integration and analysis, airframe systems, and systems for experimental validation, which will ultimately yield multidisciplinary analysis and optimization capabilities that will enable system-level design of a wide class of supersonic vehicles that will meet the emission, noise, sonic boom, and performance challenges of the future for both the civilian and military applications.

RESULTS: Validated physics-based multidisciplinary design, analysis and optimization capabilities integrated with technology development that enable the design of supersonic aircraft with sonic boom and airport noise acceptability, high temperature durability, high altitude emissions, and supersonic cruise efficiency.

AREAS OF INVESTMENT:

Propulsion-Power Systems: Tools to predict propulsion system noise, efficiency and high altitude emissions; reduced emissions combustor predictive capability, variable geometry nozzle aerodynamic predictive capability enabling low-noise at takeoff and high thrust at cruise conditions, multi-fidelity engine-aircraft structural simulation, ice accretion prediction, predictive capability for high-pressure recovery, low distortion and unstart mitigation inlets, integrated inlet-fan-nozzle predictive capability for steady-state and transient conditions.

Vehicle Systems Integration and Analysis: Tools to predict integrated vehicle performance, noise and sonic boom, installed propulsion system noise-performance trades for supersonic propulsion cycles, and integrated inlet-fan-nozzle.

Airframe Systems: Tools to predict airframe noise, lift-drag, flight dynamics, stability and handling qualities, high-fidelity computation method for achieving simultaneous gust and maneuver loads, ride quality due to elasticity, and flutter suppression control.

Systems for Experimental Validation: Systems for experimental validation of capabilities through analysis, simulation and flight research for field noise measurements and techniques, requirements for national facilities to support propulsion and airframe systems tests.

A.4 HYPERSONICS

OBJECTIVE: Perform foundational research in materials and structures, propulsion, advanced control methods, aerodynamics, aerothermodynamics, plasma dynamics, and experimental methods to enable revolutionary capabilities in propulsion systems, vehicle systems, and systems for experimental validation, which will ultimately yield multidisciplinary analysis and optimization capabilities that will enable system-level design of a wide class of hypersonic vehicles that will meet performance challenges of the future for both civilian and military applications.

RESULTS: Validated physics-based multidisciplinary design, analysis and optimization capabilities integrated with technology development for hypersonic vehicles including life cycle, risk, and gap analyses of design space for mission performance.

AREAS OF INVESTMENT:

Propulsion Systems Design: Technology development for Turbine Based Combine Cycle (TBCC) and Rocket Based Combined Cycle (RBCC) propulsion systems to aid mode transition between low-speed and high-speed flowpaths, address engine system thermal management and inlet operability.

Vehicle Systems Design: Technologies to address the physics of combustion, hypersonic flows, and entry, descent and landing.

Materials and Structures: Lightweight high temperature materials for rotating and static components, structural durability analysis methods including deterministic and probabilistic life prediction techniques and non-destructive evaluation, materials for cryogenic tanking applications, material and structure alternatives for vehicle hot structures, and methods and materials for developing improved thermal protection systems for extreme flight regimes of hypersonic flight.

Experimental Capabilities: Systems for experimental validation of capabilities through analysis, simulation and flight research for a single extreme environment sensor to measure multiple flow and structural values, optical sensors for flow characterization, multi-discipline control techniques for health monitoring, and air data system allowing air-ground communication with the vehicle traveling Mach 12+ along the horizon.